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REPORT

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OF THE
UNIVERSITY OF ILLINOIS

OF THE

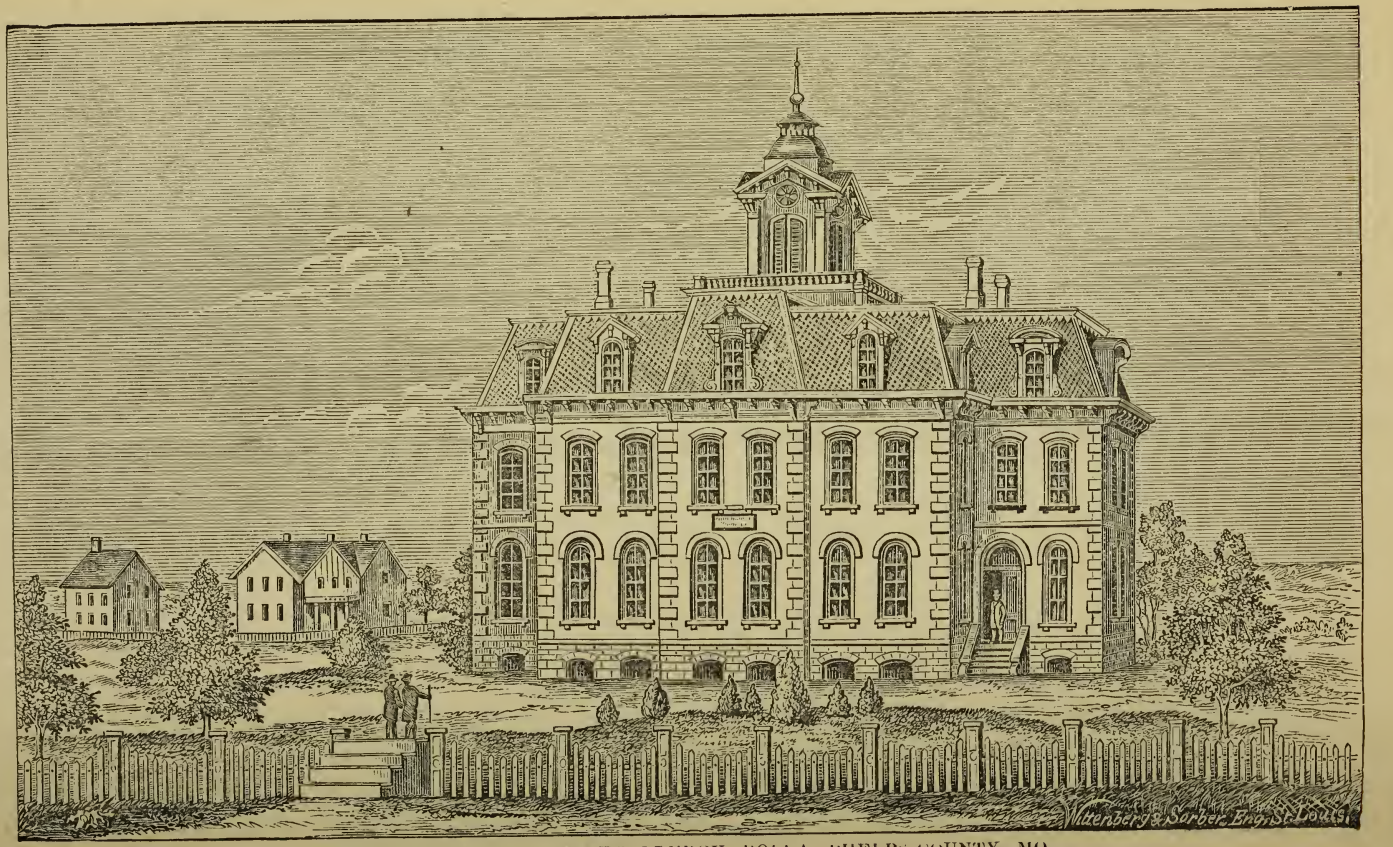
School of Mines and Metallurgy,

AT

Rolla, Phelps County, Missouri.

[FROM THE UNIVERSITY REPORT OF 1881-2]

JEFFERSON CITY:
TRIBUNE PRINTING COMPANY, STATE PRINTERS AND BINDERS.
1882



SCHOOL OF MINES AND METALLURGY, ROLLA, PHELPS COUNTY, MO.

REPORT

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Missouri University.

SCHOOL OF MINES AND METALLURGY,

Rolla, Phelps County, Missouri.

ANNOUNCEMENT AND REGISTER,

FOR THE YEAR ENDING JUNE 8th, 1882.

BOARD OF CURATORS.

JOHN S. CLARKSON, A. M.	Columbia	Term expires Jan. 1, 1883.
JERRE C. CRAVENS, ESQ	Springfield	
JUDGE JAMES LINCOLN	Clay County.	
HON. WM. F. SWITZLER	Columbia	Term expires Jan. 1, 1885.
JAMES R. ESTILL	Howard Co.	
A. M. MILLARD	Rolla	
HON. JAMES S. ROLLINS, LL. D	Columbia	Term expires Jan. 1, 1887.
CHARLES C. BLAND, ESQ	Rolla	
WILLIAM H. LACKLAND, ESQ	St. Louis	

OFFICERS OF THE BOARD.

HON. JAMES S. ROLLINS, LL. D ..... President.
JERRE C. CRAVENS, ESQ ..... Vice-President.
ROBERT L. TODD, Secretary.
RICHARD BEVERLY PRICE, Treasurer.

SCHOOL OF MINES.

EXECUTIVE COMMITTEE.

JUDGE CHARLES C. BLAND, Chairman ..... Rolla.
A. M. MILLARD, ESQ ..... Rolla.
JERRE C. CRAVENS, ESQ ..... Springfield.
C. H. FROST, Treasurer ..... Office at Rolla.
PROF. R. W. DOUTHAT, Secretary Executive Committee.

FACULTY.

Samuel S. Laws, LL. D.,
President.

Chas. E. Wait, C. E., M. E. (Director),
Professor of Analytical Chemistry and Metallurgy.

Maj. Geo. D. Emerson, M. E.,
Professor of Civil and Mine Engineering and Graphics.

Rob't W. Douthat, A. M., Ph. D.,
Professor of Languages, Principal of Preparatory Department and Secretary for Faculty.

Geordie Z. Whitney, A. B., LL. B. (Univ. Mich.),
Professor of Mathematics.

Miss Florence E. Whiting,
Assistant in Preparatory Department and Recording Secretary.

Prof. Geordie Z. Whitney,
Librarian.

GRADUATES.

Duncan, Gustavus H., C. E.	1874	Boulder, Col.
Gill, John H., C. E.	1874	U. S. Eng. Dept., Washington, D. C.
Pack, John W., M. E.	1874	Assayer, Helena, Montana.
Deegan, Francis J., C. E.	1875	Surveyor for St. L. & San Francisco R. R.
Hare, Almon W., M. E.	1875	Leadville, Col.
Emerson, Cyrus H., C. E.	1876	Dennison, Texas.
Garvens, Oscar E., M E.	1876	Lead City, Dakota Ter.
Greason, John D., M. E.	1876	Druggist, Ironton, Mo.
McGrath, John E., C. E.	1876	U. S. Coast Survey.
Minger, William C., M. E.	1876	Boulder, Col.
Ohmann-Dumesnill, A. H., M. E	1877	M. D., St. Louis.
Pack, James A., M. E.	1877	Butte City, Montana.
Millsaps, Thomas H., C. E.	1877	South America.
Brown, Wilton R., M. E.	1878	Assayer of Shakespeare Gold and Silver Min. Co., Shakespeare, Grant County, New Mexico.
Grabill, Lee R., M. E.	1878	Assayer, Rosita, Col.
Bean, William Y., C. E.	1878	Engineer Mo. Pacific R. R.

Coppedge, Lindsay L., C. E.	1878	Engineer, Missouri Pacific R. R.
Winters, Chas. F., M. E.	1879	Assayer, New Mexico.
Hoyer, Rudolph C., C. E.	1879	U. S. Eng. Dept., City of Mexico.
Carson, Arthur C., M. E.	1880	Butte City, Montana.
Smith, Lorin X., M. E.	1880	Topog. Eng. Kansas City & Memphis R. R.
Smith, Lorin X., C. E.	1881	" " " " " "
Summers, Edward B.	1881	Engineer, Missouri Pacific R. R.
Wishon, Walter W.	1881	Colorado Springs, Col.

LICENTIATES.

Blow, Peter E. (Anal. Ch.)	1875	Supt. Granby M. and S. W'ks, Granby, Mo.
McGuire, John (Chem. and C. E.)	1875	Ast. Eng. Calumet M., Lake Superior, Mich.
Whiting, Florence E. (Math.)	1875	Teacher School of Mines.
Winters, Christian R. (Anal. Ch.)	1875	Assayer, Leadville, Col.
Blanchard, Eliphalet (Anal. Ch.)	1876	Steelville, Mo.
Thiele, Lewis W. (Anal. Ch. and Met.)	1878	Assayer, Salida, Col.
Briegel, Gustavus A. (Land Surv.)	1878	Trenton, Mo.
Owen, John R. D. (Book-keeping)	1878	Student, Rolla, Mo.
Tobien, John H. (Book-keeping)	1878	Clerk, Neosho, Mo.
Wetter, Edward T. T. (Gen'l Chem)	1878	Milwaukee, Wis.
Bishop, Jennie (Book-keeping)	1879	Married, Rolla, Mo.
Bishop, Julia (Book-keeping)	1879	Married, Rolla, Mo.
Hood, Tillie (Book-keeping)	1879	Richland, Mo.
Gallaher, Philip C. (Book-keeping)	1879	Student, Rolla, Mo.
Sally, James B. (Book-keeping)	1879	County Clerk's office, Rolla, Mo.
Wishon, Chas. (Book-keeping)	1879	Rolla, Mo.
Lane, Thos. E. (Teacher's Certificate)	1880	Regular Teacher, Rolla, Mo.
Snelson, W. H. (Teacher's Certificate)	1880	County Surveyor, Rolla, Mo.
Strine, Jno. H. (Teacher's Certificate)	1880	Regular Teacher, Rolla, Mo.
Pack, Annie A. (Book-keeping)	1881	Student, Pacific, Mo.
Strine, David S. (Book-keeping)	1881	Rolla, Mo.
Johnson, Uriah H. (Book-keeping)	1881	Teacher, Fourche a Renault, Mo.
Wilson, Dora E. (Teacher's Certificate)	1881	Teacher, Pacific, Mo.
Wilson, Carrie B. (Teacher's Certificate)	1881	Student, Rolla, Mo.
Stiff, Lelia B. (Teacher's Certificate)	1881	Rolla, Mo.

COURSES OF STUDY.

Parents or guardians are requested to designate the course or the studies they wish their sons or wards to pursue.

These courses are all independent of each other, so that the student who wishes an education and not a Diploma or Certificate may pursue parts of all the courses.

TEACHER'S COURSE FOR FIRST CLASS CERTIFICATE.

FIRST YEAR.

First Semester.	Second Semester.
Higher Arithmetic.	Botany, *Gray's.*
General Grammar.	Higher Arithmetic.
Word-Analysis, *Swinton's.*	General Grammar.
Physical Geography, *Guyot's.*	Word-Analysis, *Swinton's.*
English History.	English History.
Anatomy, Physiology and Hygiene, *Cutter's.*	English Literature, *Hart's.*

SECOND YEAR.

First Semester.	Second Semester.
Book-keeping, *Rohrer's.*	Rhetoric, *Hart's.*
Algebra, *Olney's.*	Civil Government, *Townsend's.*
Geometry, *Davies' Legendre.*	Algebra, *Olney's.*
Physics, *Peck's Ganot's.*	Logic, *Coppee's.*
Theory and Practice.	Chemistry, *Norton's.*
Map Drawing.	Physics, *Peck's Ganot's.*
Astronomy, *Loomis'.*	Elocution, *Hamill's.*

PREPARATORY AND SPECIAL—FIRST DIVISION—MISS FLORENCE E. WHITING—FIRST AND SECOND SEMESTER.

Hour.	Study.	Remarks.
9—10	Higher Arithmetic	The entire subject.
10—11	Rhetoric and Comp. (Hart's)	The entire subject.
11—12	Eng. History & Civ. Gov	The entire subject.
12— 1	Gen'l Gram. & Word Anal	The entire subject.
2— 3	Algebra (Olney's)	First Term to Part II.; 2d finish.
3— 4	Book-keeping (Rohrer's)	Through Merchant's Acc'ts.

LITERARY AND SPECIAL—SECOND DIVISION—PROF. R. W. DOUTHAT—FIRST AND SECOND SEMESTER.

Hour.	Study.	Remarks.
9—10	German Drama	Written and Oral Translation, 80 Lessons.
10—11	German Reader and Conver	Written and Oral.
11—12	German Exercise Book	Written and Oral Translation.
12— 1	Latin Classics	Written and Oral Translation.
2— 3	Latin Exercises and Reader	Written and Oral Translation.
3— 4	Eng. Lit. and Logic	The subjects entire.
4— 5	Anat., Phys. and Hygiene	Tuesdays and Wednesdays, entire subject.
4— 5	Book-keeping	For Banking, Railroading, Steamboating, and Mining and Manufacturing Companies, on Thursdays, Fridays and Saturdays.

To those who complete the Teacher's Course and pass a creditable examination thereon, certificates of proficiency will be awarded, and we have the assurance of the State Superintendent of Public Schools that his certificate—first class for two years—will be issued to all those who receive the School of Mines' Certificate on this course. Thus double honors attach to the completion of the Teacher's course. Moreover, to those who do not expect to teach, this course furnishes all the studies required for a good English education.

The Book-keeping required in this course is that of Merchants' Accounts for Retail, Wholesale and Commission; but to those who desire the fuller course, full instruction will be given in Banking, Railroading and Steamboating.

Certificates will be issued on a Book-keeper's course to all those who complete the following studies:

Word-Analysis, English Grammar, Higher Arithmetic, and Book-keeping *in all its forms*, for Merchants' Accounts, Banking, Railroading, Steamboating and for Mining and Manufacturing Companies. The necessary Blank-books for this course are a Waste Journal (2 quires, 40c.), a Waste Ledger (2 quires, 50c.), a No. 1 Journal (2 quires, 60c.), and a No. 1 Ledger (2 quires, 75c.). Half these books are sufficient for those who study only Merchant's Accounts.

PREPARATORY DEPARTMENT.

For the benefit of persons who have not enjoyed such facilities elsewhere, a Preparatory Department has been established. The School of Mines does not undertake to do the work which the common schools are able and willing to do, and candidates for admission to this department must, therefore, pass examination in the following branches, viz.: Spelling, English Grammar and Arithmetic.

The Preparatory Course is shown in the following schedule:

First Term.—Algebra, to Part II., *Olney;* Higher Arithmetic; Word Analysis, *Swinton;* Rhetoric, *Hart;* Physical Geography, *Guyot;* Physics, *Peck's Ganot;* and Drawing, Freehand and Ornamental.

Second Term.—Algebra, Elements completed, *Olney;* English Literature, *Hart;* Logic, *Coppee;* Chemistry, *Norton;* Botany, Structural and Systematic, *Gray;* Rhetoric, *Hart;* Drawing, Freehand and Ornamental; and Plane Geometry.

FOR THE DEGREE OF MINING ENGINEER.

First Year.

First Term.—Chemical Philosophy, General Chemistry, Blowpipe Analysis, Field Practice, Drawing, Solid Geometry, and Trigonometry.

Second Term.—General Chemistry, Analytical Chemistry, Determinative Mineralogy, Land Surveying, Physics, Drawing and Descriptive Geometry.

Second Year.

First Term.—Analytical Chemistry, Quantitative Analysis, Mineralogy and Geology, Metallurgy, Higher Surveying, Drawing, General Geometry and Calculus, and Higher Algebra.

Second Term.—Geology; Analytical Chemistry, Quantitative; Assaying, Metallurgy, Mine Engineering, Steam Engine, Drawing, General Geometry and Calculus.

Third Year.

First Term.—Analytical Chemistry, Quantitative; Metallurgy, Mine Engineering, and Mechanics.

Second Term.—Analytical Chemistry, Quantitative; Graduation Thesis.

FOR THE DEGREE OF CIVIL ENGINEER.

First Year.

First Term.—Chemical Philosophy, General Chemistry, Blowpipe Analysis, Field Practice, Drawing, Solid Geometry and Trigonometry.

Second Term.—General Chemistry, Analytical Chemistry, Determinative Mineralogy, Land Surveying, Physics, Drawing, and Descriptive Geometry.

Second Year.

First Term.—Roads and Railroads, Higher Surveying; Drawing, Topographical; General Geometry and Calculus, Analytical Chemistry, Geology, Astronomy, and Higher Algebra.

Second Term.—Mine Surveying, Steam Engine; Drawing, Mechanical; General Geometry and Calculus, Analytical Chemistry, Quantitative (optional); Geology, Civil Engineering.

Third Year.

First Term. — Field Work, Railroad Location, etc., Mechanism, Drawing, Mechanics.

Second Term.—Practical Topography, Drawing, Assaying, Graduation Thesis.

GIRLS' COURSE IN ARTS.

First Year.

First Term, ending February 7th.	Higher Arithmetic	*2½
	General Grammar	2
	Word-Analysis	1½
The studies named in this term require for preparation and recitation full 12 hours.	Physical Geography	1
	United States History	2
	Anatomy, Physiology and Hygiene	2
	Freehand and Ornamental drawing	1
Second Term, ending June 9th.	Botany	1
	English History	2
	English Literature	2½
The studies named in this term require for preparation and recitation full 12 hours.	Rhetoric	2
	Civil Government	1
	Latin or Greek begun	2½
	Freehand and Ornamental Drawing	1

Second Year.

First Term, ending February 7th.	Book-keeping through Merchants' Accounts	2½
	Algebra	2½
The studies named in this term require for preparation and recitation full 12 hours.	Physics	1
	Latin or Greek continued	2½
	German, French or Spanish begun	2½
	Drawing	1
Second Term, ending June 9th.	Algebra finished	2½
	Physics	1
	Logic	1½
The studies named in this term require for preparation and recitation full 12 hours.	Chemistry	1½
	Latin or Greek continued	2½
	German, French or Spanish continued.	2½
	Drawing	1

*The figures opposite the studies indicate the time required for preparation and recitation.

Third Year.

First Term, ending February 7th.	Geometry	2
	Mineralogy	1
	Geology	1
	Astronomy	1
The studies named in this term require for preparation and recitation full 12 hours.	Roman History	2
	Latin or Greek continued	2
	German, French or Spanish	2
	Drawing	1
Second Term, ending June 9th.	Trigonometry	2
	Mensuration	2
	Latin or Greek	2
The studies named in this term require for preparation and recitation full 12 hours.	German, French or Spanish	2
	Geology	1
	Grecian History	2
	Drawing in water colors and oil	1

Fourth Year.

First Term, ending February 7th.	Analytical Geometry	2
	Descriptive Geometry	2
	Latin or Greek	2
The studies named in this term require for preparation and recitation full 12 hours.	German, French or Spanish	2
	Mediæval History	2
	Drawing in water colors and oil	2
Second Term, ending June 9th.	Calculus	2
	Chemistry and Laboratory Work	3
	Psychology	2
The studies named in this term require for preparation and recitation full 12 hours.	Political economy	2
	Drawing in water colors and oil	2
	Preparation of Thesis for Graduation	1

In addition to the studies named above, this course requires alternate weekly reading or recitation and essay writing. These studies are not named in the course, because they simply take the place of other studies on Saturday afternoon, and do not, therefore, increase the amount of labor.

FOR THE DEGREE OF BACHELOR OF PHILOSOPHY.

First Year.

First Term.—Chemical Philosophy, General Chemistry, Blowpipe Analysis, Field Practice, Drawing, Solid Geometry and Trigonometry.

Second Term.—General Chemistry, Analytical Chemistry, Determinative Mineralogy, Land Surveying, Physics, Drawing and Descriptive Geometry.

Second Year.

First Term.—Analytical Chemistry, Quantitative Analysis, Mineralogy and Geology, Metallurgy, Higher Surveying, Drawing, General Geometry and Calculus, and Higher Algebra.

Second Term.—Geology, Analytical Chemistry, Quantitative Assaying, Metallurgy, Steam Engine, Drawing, General Geometry and Calculus.

Third Year.

First Term.—Analytical Chemistry, (Quantitative) and Assaying; Metallurgy, Mechanics and Mechanism.

Second Term.—Analytical Chemistry, Quantitative; Graduation Thesis.

OPTIONAL COURSE.

Open to all Students, but Required of None.

Book-keeping, in all its forms, for Merchants' Accounts, Retail, Wholesale and Commission; and for Banking, Railroading and Steamboating.

Latin and Greek, according to the fullest course of first-class Colleges or Universities. The study of these languages may be commenced at the beginning of the first or second semester. The pronunciation given to Latin is either the German or the English, according as the student wishes to continue the study in Germany or the United States.

The principal modern languages, German, French and Spanish, are also taught; and to each the student may devote one, two, three or four years, taking an extended course in reading, writing and conversation. An effort is made to train the *eye*, the *ear*, the *tongue* and the *hand*, so that each student may read at sight any of these languages, understand them when they are spoken, pronounce them properly and fluently, and write them correctly and readily.

In Drawing, those who have a taste for the ornamental can pursue to any length Pen-and-Ink Sketching and Painting in Water Colors and Oil. These branches, although belonging, for the most part, to an æsthetic rather than to a useful education, nevertheless offer to young ladies and to young gentlemen of leisure the means of securing an accomplishment equal in every respect to that of music.

In addition to the course of Ornamental Drawing, those who so desire can obtain instruction in Architectural and Mechanical Drawing.

DEPARTMENTS OF INSTRUCTION.

MATHEMATICS.

Professor Whitney.

Inasmuch as the student of Engineering can scarcely read the primers of his profession without a considerable knowledge of Mathematics, and in recognition of the importance of Mathematical studies from an educational as well as from a professional point of view all the work mentioned below, with the exception of 12, running through the entire course, save the last Semester of the last year are required of all students candidates for a degree.

While special attention is given to the mental discipline of the student in the logical development of the Mathematical processes as *arguments*, the great practical end of preparing him to attack the problems of physical science by the Mathematical method with its enormous advantanges is never for a moment lost sight of.

The attention of those contemplating entering upon the studies of the first year is called to a remark of Prof. Ficklin, found in another part of this report, in which he says: "Imperfect preparation in Algebra is so common as to compel the conviction that sufficient attention is not given to this branch of mathematics in many of the preparatory schools of the State. Its importance can not well be over-estimated.

The course of study is as follows:

Preparatory Year.

First Semester.

1. Arithmetic, (completed).
2. Algebra to Part II, (Olney), 5 times per week.

Second Semester.

3. Algebra, (elements completed), 4 times per week.
4. Plane Geometry, (Davies' Legendre), 3 times per week.

First Year.

First Semester.

5. Solid Geometry, 2 times per week.
6. Trigonometry, (Olney), 3 times per week.

Second Semester.

7. Descriptive Geom., Shades and Shadows, (Church), 4 times per week.

Second Year.

First Semester.

8. Higher Algebra, (Olney), 2 times per week.
9. General Geometry and Calculus, (Olney), 4 times per week.

Second Semester.

10. General Geometry and Calculus, 4 times per week.

Third Year.

First Semester.

11. Mechanics, 4 times per week.

Second Semester.

12. Advanced Gen. Geom. and Calculus, 4 times per week.

Studies must be taken in the *order* indicated above, except that course 8 may follow immediately after course 3, and courses 9, 10 and 11 may be taken before course 7. Course 10 is a continuation of course 9. While course 12 is optional, it is thought there will be a sufficient number of students who appreciate the importance of extending their researches to warrant the formation of such a class. Some such treatise as that of Courtenay or Williamson will be made the basis of instruction.

The studies of the first year can not be taken up until a satisfactory examination has been passed in Arithmetic, the Algebra of the preparatory year—comprising the fundamental rules, factoring, fractions, simple equations with one or more unknowns, involutions and evolution, the calculus of radicals, ratio, proportion, the progressions, quadratic equations, equations of higher degrees which may be solved after the manner of quadratics, pairs of simultaneous equations which may be solved by general methods or by easily recognized expedients and the *use* of logarithms—and Plane Geometry.

The Arithmetic and Algebra of the preparatory year are taught by Miss Whiting.

GENERAL CHEMISTRY.

Professor Wait.

Instruction in this department is given to two classes—the Preparatory, and First class.

Preparatory Class.

In this class, chemistry is commenced with the second semester, and is continued throughout the year. The class is taught the elements of the subject, being fully illustrated by instructive and interesting experiments, and such information is given, aided by suitable text-books, as will prepare them for the higher class in general chemistry, and also for entering upon laboratory work, which is commenced the following year.

First Class.

The duties of this class continue throughout the year; there are four recitations each week. Chemical philosophy is first introduced and continued through a part of the first semester, and the application of arithmetic to chemistry is given a prominent place in this semester. Students are required to perform numerical examples, thereby fitting themselves for the solution of many questions constantly occurring in the advanced department of analytical chemistry.

The remainder of the year is given to a complete course in theoretical chemistry. A careful study is made of the non-metallic and metallic elements, and important compounds of each. The latter part of the course is devoted to organic chemistry, with special reference to the chemistry of vegetable and animal life.

ANALYTICAL CHEMISTRY.

Professor Wait.

First Year.—Blow-pipe Analysis (Elderhorst's Manual); Qualitative Analysis (Fresenius).

Second Year.—Quantitative Analysis (Fresenius); Quantitative Analysis (Fresenius).

Third Year.—Quantitative Analysis (Fresenius); Assaying (Mitchell).

Instruction in this Department is thoroughly practical, and extends throughout the first, second and third years. There is a commodious laboratory, supplied with necessary apparatus, also balance room and mineral collection. In the basement are furnaces, which are used in the assay of ores.

First Class.

The students in this class spend four hours each day at practical work; each one is provided with a working table, apparatus and chemical reagents.

The course is begun with blow-pipe work; the student is made acquainted with the reaction of known bodies, and he is then required to perform the experiments for himself, thus becoming familiar with the behavior of such bodies before the blow-pipe, and enabling him to detect, with almost certainty, the composition of substances given to him for identification.

Qualitative analysis is also taken up, and is taught by lectures and experiments; the student being required to repeat, at his working table, the tests for bases and acids which have been shown to him. After passing through a systematic course of qualitative analysis, he is required to analyze and report upon substances given to him, including mixtures of salts, also alloys, ores of lead, copper, zinc, antimony, iron, etc., etc., soils, insoluble silicates and mineral waters.

Determinative mineralogy is also entered upon; the composition of minerals is ascertained by the blow-pipe.

Second and Third Classes.

Quantitative analysis constitutes the work of these classes. Those students who have completed satisfactorily the work given to them during the first year, and who have passed a practical examination, lasting one week, are allowed to commence quantitative analysis. The work commences with the analysis of substances whose compositions are known; there is thus a check upon the accuracy of the student's work.

The quantitative course includes analyses, either partial or complete, of the following series, each estimation being, at least, duplicated:

(*1) *Zinc Sulphate;* (2) *Barium Chloride;* (3) *Alum;* (4) *Chrome Alum;* (5) *Sulphate of Iron and Amonia;* (6) *Blue Vitriol;* (7) Calcite; (8) Calamine; (9) Galena; (10) Chalcopyrite; (11) Orthoclase; (12) Kaolin; (13) Hematite; (14) Pyrolusite and Chlorine, valuation; (15) Soda Ash, valuation; (16) Bleaching powder, valuation; (17) Cerusite; (18) Smithsonite; (19) Blende; (20) Coal, proximate; (21) Coal, ultimate and heating power; (22) Stibnite; (23) Realgar; (24) Blast furnace slag; (25) Lead furnace slag; (26) Pig iron; (27) Bismuth litharge; (28) Commercial lead; (29) Spelter; (30) Native bismuth; (31) Regulus; (32) Beryl; (33) Zicon; (34) Illmenite; (35) Chromite; (36) Salpetre soil; (37) Mineral water.

Besides this course, there is the usual practice in the fire assay of the ores of lead and silver, of argentiferous and auriferous native compounds and artificial products, and in the domestic valuation of the ores and the most prominent metals.

Special students may enter this department at any time, and may pursue, at their discretion, the study and analysis of any class of ores of metallurgic products. Young men, who have neither the time nor means to spare, to take the full course, may accomplish much in the way of chemical analysis by devoting their entire time to it during the course of a single year.

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*Those in italics are *partial* analyses.

METALLURGY.

PROFESSOR WAIT.

The instruction in this department is given by lectures, supplemented by laboratory practice omitting Nos. 14, 15, 16, 32, 33, 36 and 37 of the list given under analytical chemistry, and is illustrated by diagrams, models and specimens. The course is introduced by zinc, and is followed by lead, silver, nickel, mercury, copper, iron and antimony. The principles of furnace construction, of slag formation, and of general metallurgical operations, are discussed throughout the course, and special illustrations are given of all the methods described. The students are required to solve problems involving the discussion of the desirable methods of treatment of ores of stated composition, under given economical conditions, and to accompany the solutions with plans and estimates for works to carry out the method. In the lectures and other exercises of this department, full cognizance is taken of the peculiar economic conditions surrounding metallurgical industry in this country, and especial reference is had to the staple metallic products of Missouri—iron, lead and zinc. Studies are made of the local iron establishments, and excursions are made to other iron works, as well as to those at which lead and zinc ores are practically treated.

PHYSICS.

The apparatus for illustration in this department is already very complete. The instruction, for the present, is divided between Professors Wait, Emerson and Whitney

GEOLOGY AND MINERALOGY.

In the preparatory year, the students have recitations and lectures and physical geography; in the first year, recitations and lectures in descriptive mineralogy, and laboratory exercises, in the determination of a series of fifty-five well selected mineral species, with special reference to the ores of the metals and their associated gangues. These exercises are followed, in the second year, by lectures and recitations (based on Dana's Manual) on dynamical and historical geology. The lectures on Lithology, and on mineral veins and ore deposits, together with an account of the chief geological features and modes of occurrence in the principal mining districts, complete the course.

CIVIL ENGINEERING.

PROFESSOR EMERSON.

In this department, practical work in the field forms a prominent, and, as we believe, a somewhat distinctive feature. The use of instruments in the field, by all the students of Civil Engineering, begins with the second semester of the first year, and is continued throughout the course. A complete familiarity with the manipulation of all the instruments in common use by engineers and land surveyors, is taught to the students by systematic practice, in the room and in the field. He is made familiar with the chain and all its capabilities; the needle compass, the solar compass, the transit instruments, the leveling instrument, the sextant, the barometer, and the various tools used in drawing and plotting. Friday, and sometimes Saturday, of each week, is devoted to practice in the field, and where necessary, a long time is taken for excursions to the mines, furnaces, bridges and railroad constructions of the country.

The field practice consists of land and railroad surveying, by all the methods in use, or described in the books. Tracts of land, roads and streams are surveyed and plotted; contours of the adjacent country are made with the leveling instrument, the barometer, etc.; railway curves are calculated and set out upon the ground; earthwork is measured and estimated from the embankments and excavations of the railroad. A general system of triangulation of the country about Rolla, is begun from a base line carefully laid by the students, which will be extended from time to time for their instruction.

Such parts of astronomy as relate to land surveying or engineering, are carefully studied, and are illustrated by stellar and solar observations.

A general course of descriptive engineering, on the basis of Mahan's Civil Engineering, revised by Professor Wood, runs through the second semester of the second year.

Gillespie's treatise upon Roads and Railroads, forms one of the studies of the Engineering course.

GRAPHICS.

PROFESSOR EMERSON.

During the preparatory year, the students are instructed in the elements of drawing, with pen and pencil, according to the principles contained in Chapman's Drawing-book. They are also practiced in freehand drawing. These exercises develop the special tendencies of the student, and enable the Professor to judge in what direction his greatest strength lies, and where his week points most need to be reinforced.

During the first year, the practice is in topographical drawing, with pen and India ink, representing the lines of contour of the earth's surface, showing the bounding curves which would limit the surface in case of a gradual rise of water; taken at every 5, 10 or x feet. The hatching lines of declivity are drawn; also, the various conven-

tional representations of surface. The students are exercised in a carefully organized method of drill in printing, in order to acquire a rapid system of lettering—of essential importance in finishing maps, problems, title pages and mechanical drawings. There is also a careful study of the true standards of the three colors, with their secondary and ternary combinations, simultaneous contrasts, harmonies, unisons, aerial perspective, and the important practical application of laying on flat tints. This is followed by applications to colored topography, etc.

The second year's exercises are in construction of problems in descriptive geometry, and in shades, shadows and perspective. The problems are drawn with pen and India ink on demy drawing paper, and all are constructed on mathematical principles, displaying all the difficult problems of the intersection of curved surfaces, and the representations of warped surfaces having two or three directrices.

In the third year, the subject of stereotomy is taken up, in its applications to the various problems of stone-cutting and the construction of terre-pleins, ramparts, ramps and embrasures of permanent fortifications. There are also required drawings of bridges, furnaces, machines, their shadows and perspective, as they would appear to the eye, at a finite distance from the perspective plane, mathematically constructed and properly colored.

Those who possess the requisite taste for such subjects, may be exercised in pen, India ink and color drawings of landscapes, figures, etc., and be led to apply their acquirements to natural history.

MINE ENGINEERING.

Professor Emerson.

This is taught entirely by lectures. The subjects of systems and attack and exploitation of mineral deposits; of shafts, adits and levels; timbering of mines; subterranean transportation, hoisting, pumping, surface transportation, and mechanical concentration, are considered in elaborate detail.

The course is fully supplemented by extended field practice, the important parts of the civil engineering course, the field and office work of the geological department, and by extended instruction in assaying and analytical chemistry, and in drawing plans and sections of mines, and the result of the practical work.

MECHANISM.

Professor Emerson.

An extended series of lectures is given upon this important subject, which is intended to be a descriptive epitome of the principles which govern, and the forms and

mode of construction of machines used in all industrial pursuits, embracing prime movers, machines of transmission, and as much as is possible in the course of applied machinery.

Steam Engine.

A series of lectures is given, historical, descriptive and theoretical, of the steam engine, embracing all the varieties in use, and their special applications.

FEES, EXPENSES, ETC.

The fees for instruction, etc., at the School of Mines and Metallurgy, are the same as at the other departments of the University, viz: An annual entrance fee of $10, besides an assessment of $5 per semester, for incidentals and for the use of the library. Special and partial students are subject to the same charges; an exception, however, is made against those devoting their time to analytical chemistry or assaying. Such pay a small additional fee for chemicals consumed. All laboratory students furnish their own blow-pipes, platinum, crucibles and apparatus, silver and gold solutions, alcohol for heating purposes, and pay for apparatus damaged or broken, while in their service. A deposit covering the value of the apparatus issued, is required to be placed in the hands of the treasurer by each laboratory student. This deposit, less the value of the breakage, is returned at the close of the year.

The exercises of the drawing room require also a small expenditure, annually, for materials. Text-books and all requisite materials for students can be procured in Rolla, either from dealers, or, in the case of chemical apparatus, from the school, at the usual rates.

A fee of $5 must be paid, before graduation, for the diploma, and a fee of $1 for the certificate of proficiency.

The courses of study will be rigidly enforced on all students, candidates for the degrees of the institution. The professional degrees awarded are Civil Engineer (C. E.,) Mine Engineer (M. E.,) and Bachelor of Philosphy (Ph. B.). Students, not candidates for degrees, or special students, are admitted at any time, and are allowed the fullest liberty in the selection of their studies, provided always, that such shall have the equivalent of at least sixteen recitations, weekly. To these classes of students, certificates of proficiency are granted, on satisfactory examination being passed. These certificates and the diplomas are issued only at the public commencement.

Admission.

For admission to First Year studies, students must be at least sixteen years of age, and must pass satisfactory examination in Arithmetic, English Grammar, Word Analysis, Preparatory Chemistry, Physical Geography, Rhetoric, Elements of Algebra and Plane Geometry.

Special students, in any department, are admitted without previous examination.

Before matriculation and entrance upon the duties of the school, the treasurer's receipt for entrance fee, and for the incidentals of the semester, must be shown to the Director, and a card, properly endorsed, be procured from him. The Secretary of the Faculty will then place the student's name upon the roll, and furnish him with all necessary information.

The collegiate year begins on the third Monday in September, and an examination for admission to the *regular* course is held on Monday and Tuesday of the same week. There is no suspension of exercises, other than for examination, between the two semesters of the year.

Good boarding, at places approved by the Faculty, can be obtained at from $3.50 to $4.00 per week. A list of such places can be seen on application to the secretary. Expenses for board may be reduced from one-third to one-half, by a judicious system of clubbing in rented rooms. The school has no dormitories under its control.

Patrons will please notice the following estimates :

Tuition in any or all studies, per term of five months	$10.00
Board, fuel, washing, lights, etc	68.62
Books, from $10 to $15	12.50
Contingent expenses for Laboratory students	10.00
Total	$101.12

From this estimate it will be seen that no student needs over $101.12 per term, and most students only $91.12, only those working in the Chemical Laboratory having to pay contingent expenses.

Parents should let their sons and daughters have very little pocket money ; the student does not need much. In fact, pocket money is to the student away from home a positive injury, leading him not only to extravagance, but also into the formation of evil habits. Give him money at any other time, but not when away at school.

Historical, Etc.

The School of Mines and Metallurgy—a department of the University of the State of Missouri—is located at Rolla, Phelps county, on the line of the Atlantic and Pacific Railroad, one hundred and thirteen miles southwesterly from St. Louis. The locality is pre-eminently healthy, is in the midst of an extensive and rapidly developing iron section, with districts abounding in lead and zink deposits, within easy access, and thus affords excellent opportunities for the field study of some of the modes of occurrence of the ores of these metals, as well as for the practical investigation of their methods of treatment. Excursions for such purposes will constitute a prominent feature in the instruction of the advanced classes.

The institution was created by the legislative act of February, 1870, disposing of the Congressional grant of land for agricultural and mechanical colleges. It was formally opened November 23, 1871. The first class, of three members, graduated in June, 1874, having completed the full course. The eleventh year of the Institution closes with this announcement and catalogue.

The design of the School of Mines and Metallurgy, in connection with the Agricultural College, is to carry out, to its amplest extent, the intention of the act of Congress, providing for education in the Industrial arts. This has been kept prominently in view in arranging the curriculum of the school, in the selection of its apparatus, in providing its equipments, and in the organization of its Faculty. It is a school of Technology, with Civil and Mine Engineering and Metallurgy, as specialties.

The school is well furnished with apparatus, instruments, and other appliances for practical instruction and demonstration. It has a full supply of excellent surveying and engineering instruments, physical apparatus, embodying the newest forms for illustration and research, together with diagrams and models for the illustration of

metallurgy, and for engineering, topographical and ornamental drawing. The geological, mineralogical and technical collections are all rapidly increasing, and are already rich in specimens and products illustrative of the mineral industries of Missouri. The laboratories for analyses and assaying have been increased in working capacity, and are amply furnished with apparatus and reagents necessary for practical instruction, and for any line of chemical and metallurgical research. The library has been selected with special reference to supplementing the labors of the class and lecture rooms, and consists, therefore, largely of standard reference works on the physical sciences, mathematics and technology. A good selection of technical periodicals is supplied to the reading room, and strong efforts will be made to keep the collection of these and of the books, up to the progress of the several departments. The same may be safely promised for the apparatus, collections, modals and other adjuncts to the proper working of a school of this character.

The class and other rooms of the building are comfortably furnished, well lighted and well ventilated. The first floor is occupied by the analytical laboratory, the chemical lecture room, and the room of the professor of geology. On the second floor are the public hall, the office, library, reading and engineering rooms; and in the third story are the rooms of the professors of mathematics and English, and a large drawing room, with ample accommodations for upwards of eighty students. The basement contains the assay furnaces and other appliances for metallurgical work. The laboratory is supplied with gas for the heat required in chemical analysis.

With regard to the equipment, organization and effective character of the work of the school, the following from the official report of the visit and examination of the Committee on Mines and Mining, of the Twenty-Eighth General Assembly, may be cited:

"We do not intend to eulogize this Institution with high-sounding phrases, nor do we mean to under-rate the difficulty that each undertaking meets with, during its incipient stage; but with pride we acknowledge the unanimous opinion of your Committee, that this school is highly worthy of the people of the great State of Missouri, and in full coincidence with the intent which led to its creation. We may look forward with well-founded hopes that, by the practical working of this school, our dormant mineral wealth will meet the attention of the entire civilized world.

"The force of professors employed to teach the various branches of learning, has been selected with more than usual care, and their ability and devotedness justify the highest expectations.

"Analytical Chemistry, Mineralogy, Geology, Metallurgy, Mathematics, pure and applied; Drawing, artistic and mechanical; Civil and Mine Engineering, Military Tactics, etc., form the main branches of study in this institution.

"The apparatus, mathematical and philosophical instruments, are all of the latest and most approved kind, and their selection shows excellent tact, the laboratory is in good working order, and the library, consisting mainly of technical works, contains a large number of rare volumes.

"The morals of the students are vigilantly looked after, and the remarkable progress made by them is not only noteworthy, but also a source of gratification to your Committee.

"The maps of surveys and mines, the drawings of furnaces and reduction works, prepared by the more advanced students, display art and mastery on the subject of their study and labor.

"A remarkable feature of the school consists in combining theory with practice."

NINTH COMMENCEMENT OF THE SCHOOL OF MINES.

THURSDAY, JUNE 8th, 1882.

PROGRAMME.

PRAYER—MUSIC.

CONFERRING Degrees and Certificates..... President Laws.
ADDRESS on part of Graduates ..... Mr. Beauregard Ross.
ANNUAL Oration..... Hon. Thos. P. Bashaw.

MUSIC.

DEGREES CONFERRED.

CIVIL ENGINEERS.

GIBB, FRANK W., Little Rock, Ark.—Subject of Thesis: "*Proposed Bridge over the Gasconade River.*"

SCHRANTZ, ASHUAH B., Mound City, Mo.—Subject of Thesis: "*Tunnels.*"

VANDEVANDER, HERMAN N., Williamsburg, Penn.—Subject of Thesis: "*Turbine Water Wheels.*"

PAINTER, WILLIAM R., Carrollton, Mo.—Subject of Thesis: "*History of American Iron Bridges.*"

WASH, JAMES A., St. James, Mo.—Subject of Thesis: "*Improvement of Rivers.*"

MINING ENGINEERS.

GIBB, FRANK W., Little Rock, Ark.—Subject of Thesis: "*Metallurgy of Lead as Practiced at Joplin, Mo.*"

ROSS, BEAUREGARD, Houston, Mo.—Subject of Thesis: "*Metallurgy of Iron as Practiced in Missouri.*"

Parents and guardians are requested to note carefully the following dates, and to require their sons and wards to conform to the same; to remember how important it is for every student to be in place and ready to enter upon his duties when school opens; to prevent, if possible, absences before and after holidays. Any student who leaves for home before the Christmas Holidays begin, or before commencement exercises are ended, does so without the consent of the Faculty, and will be considered absent from duty.

CALENDAR.

1882.

September 18, Monday, 9 o'clock A. M..... Winter Semester begins.
December 21, Thursday, 12 o'clock M..... Close for Christmas Holidays.

1883.

January 3, Wednesday, 9 o'clock A. M..... Exercises resumed.
January 29, Monday, 9 o'clock A. M..... Half-yearly examination begins.
February 3, Saturday, 12 o'clock M..... Half-yearly examination closes.
February 6, Tuesday, 9 o'clock A. M..... Summer Semester begins.
May 29, Tuesday, 9 o'clock A. M..... Yearly examination begins.
June 7, Thursday, 10½ o'clock A. M..... Annual commencement.

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